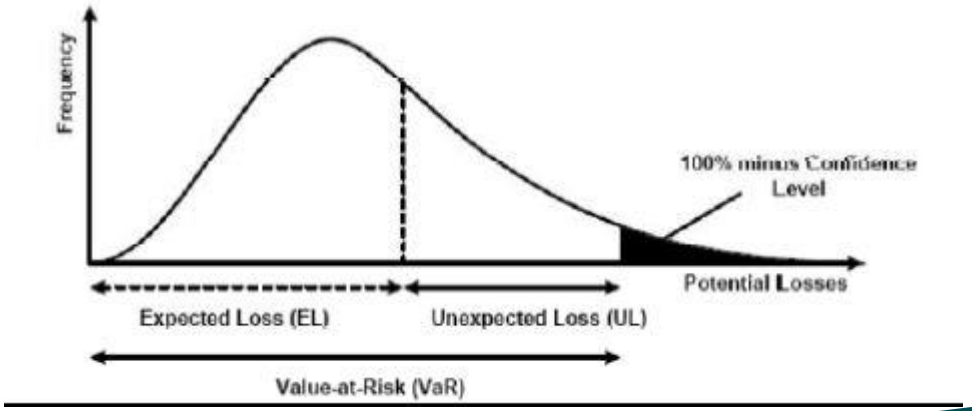
Monte Carlo Value at Risk

Monte Carlo VaR

Value at Risk (VaR) Definition

- The maximum likely loss on a portfolio for a given probability defined as *x%* confidence level over N days
- Pr(*Loss* > *VaR* (*x%*)) < 1- *x%*



Value at Risk Roles

- Risk measurement
- Risk control
- Financial reporting
- Regulatory and economic capital

Value at Risk Pros & Cons

- Pros
  - Regulatory measurement for market risk
  - Objective assessment
  - Intuition and clear interpretation
  - Consistent and flexible measurement
- Cons
  - Doesn’t measure risk beyond the confidence level: tail risk
  - Non sub-additive

Three Value at Risk Approaches

- Parametric Value at Risk
- Historical Value at Risk
- Monte Carlo Value at Risk

Monte Carlo Value at Risk

- Assumption

  Assuming market factors follow certain stochastic processes.

- Pros
  - Easy back and stress test
  - Good for high confidence level and tail risk
- Cons
  - Dependent on distribution assumption
  - Calibration required
  - Extensive computation

Monte Carlo Value at Risk Methodology and Implementation

- Assume each market factor follows certain stochastic process: $\vartheta(\sigma_i W_i)$ where W is a Wiener process
- Calibrate volatility σ_i for each market factor and pair-wise correlation ρ_{ij} for any two market factors
- Simulate market factor changes δ_i based on the stochastic processes and correlated random variables.
- Generate market scenarios $x_i = x_0 \delta_i$
- Compute scenario PVs: $P(x_i)$ and scenario P&L: $P(x_i) - P(x_0)$
- Sort all scenario P&Ls. The VaR is the number at 1% lowest level

Refrence:

https://finpricing.com/lib/EqBarrier.html